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SEMICONDUCTOR LASER WITH BUILT-IN PHOTODETECTOR

CLAIM(S)

A semiconductor laser with a built-in photo detector characterized in that a reflection film is installed on a window glass except a light-collecting section in the semiconductor laser and the light reflected at the reflection film is guided to the photo detector.

DETAILED DESCRIPTION OF THE INVENTION

(Field of Industrial Application)

The present invention pertains to a semiconductor laser with a built-in photo detector for keeping a light output at a specific level.

(Prior Art)

Fig. 3 shows a structure of the prior art semiconductor laser with a PIN built-in photo diode. In the figure, 1 indicates a semiconductor chip, 2 a PIN photo diode, 3 a stem, 4 a cap, 5 a glass window, 6 front surface light, and 7 back surface light. With this type, the light coming out of the back resonance

surface of a semiconductor laser chip is generally received by a PIN photo diode. This structure will be convenient if the front surface light and back surface light are equal in ratio, as with the case of the prior art semiconductor laser. This structure, however, will not be appropriate for a non-symmetrical laser, wherein an anti-reflection film 9 (91: alumina film with a $\lambda/4$ thickness; 92: amorphous silicon film with a $\lambda/4$ thickness) is coated on the back resonance surface of semiconductor laser chip 8 and a transmission film with a $\lambda/4$ thickness is coated on the front resonance surface, as with the case of recent high power semiconductor laser shown in Fig. 4. The light (back surface light) 11 coming out of the back resonance surface of the semiconductor laser shown in Fig. 4 is about 1/30 the light 12 (front surface light) coming out of front resonance surface. Accordingly, there is a problem that the ratio of the front surface light and the back surface light changes when the light coming out of front resonance surface is partially returned to the resonator; therefore, the output of the front surface light cannot be controlled by the back surface light.

(Objective)

The objective of the present invention is to present a semiconductor laser with a built-in photo detector free from the aforementioned problem.

(Content of the Invention)

With the semiconductor laser with a built-in photo detector of the present invention, the aforementioned problems are eliminated by installing a reflection film on the window glass other than on the light-collecting section in the center and by guiding the reflected light to the photo detector by the reflection film.

(Embodiment Example)

Fig. 1 shows the structure of the semiconductor laser with a built-in photo-detector. In the figure, 21 indicates the semiconductor laser chip, 22 the photo detector (PIN photo diode), 23 the stem, 24 the cap, 25 the window glass, 26 the anti-reflection film attached to the window glass other than to the light-collecting section, 27 the front surface light, and 28 the front surface reflection light. In a semiconductor laser, the light-expansion angle is generally very wide. The light in the central section can be focused by a lens but the peripheral light is generally disposed. The structure of the present invention is characterized by use of this disposed light. The light with +/-30° out of the light coming out to the front surface of the semiconductor laser chip goes through the window glass and is emitted, but the remaining light is reflected to the inside by the reflection film coated on the window glass. By receiving this reflection light by the photo detector (PIN photo diode), the

driving current of laser chip is fed back in the APC circuit (not shown in the figure) to stabilize the front surface light output. By this method, the photocurrent of the PIN photo diode becomes multiple times higher than that of the prior art, and the light output instability caused by the imbalance of the front surface light and back surface light when the light is returned, as shown in Fig. 2, is eliminated (A: The present invention; B: The prior art).

(Advantage)

As explained above in detail, by the present invention, a very useful semiconductor laser with a built-in photo detector, which is free from the problems of the prior art, can be presented.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows the semiconductor laser with a built-in photo detector of the present invention. Fig. 2 shows the relationship between the returned light and the front surface light output in the semiconductor lasers with a built-in photo detector of the prior art and of the present invention. Fig. 3 shows the structure of the prior art semiconductor laser with a built-in PIN photo diode. Fig. 4 shows the structure of the high power semiconductor laser chip.

1. semiconductor laser chip

2. PIN photo diode

3. stem

4. cap

5. window glass

6. front surface light

7. back surface light

8. semiconductor laser chip

9. reflection film

91. alumina film with a $\lambda/4$ thickness

92. amorphous silicon film with a $\lambda/4$ thickness

10. transmission film (alumina film with a $\lambda/4$ thickness)

11. back surface light

12. front surface light

21. semiconductor layer chip

22. photo detector (PIN photo diode)

23. stem

24. cap

25. window glass

26. reflection film

27. front surface light

28. front surface reflection light